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SHELLS FROM THE BIRD GUANO OF SOUTHEAST
FARALLON ISLAND, CALIFORNIA, WITH
DESCRIPTION OF A NEW SPECIES
OF *LIOTIA*

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In May, 1949, opportunity was afforded to spend a week on Southeast Farallon Island in company with Dr. G Dallas Hanna, Curator of the Department of Paleontology, California Academy of Sciences. The purpose was to investigate the geology of the island. A further desire was to observe existing faunal conditions and to make additions to the Academy's collections. More information on some of the lesser known aspects of the marine fauna was also desired, preliminary to an extensive oceanographic program subsequently begun in the fall of 1949 under a special contract between the California Academy of Sciences and the U. S. Office of Naval Research (N9 our 94400).

Southeast Farallon is a bare and rugged, rocky island about a mile long and half a mile wide, lying 27 miles west of the Golden Gate. It is approximately the southern end of a ridge about 30 miles long with Cordell Bank, off Point Reyes, marking its northern extremity. In between lie the North Farallon Islands, a group of four pointed rocks rising abruptly out of the sea, and the Middle Farallon, a small rock that is awash at high tide. The North Farallons are uninhabited; so far as known, no one has made a landing on them for at least half a century. Southeast Farallon, however,

lies directly in the ship lane from San Francisco to Honolulu, and the U. S. Coast Guard maintains a permanent establishment there for the operation of a lighthouse, foghorn, and radio installations for various purposes, including the transmission of weather reports.

Southeast Farallon is noted for the vast number of birds that nest there. Here are the great rookeries of the California murre and of cormorants of three species—the Farallon, the Baird, and the Brandt. Other birds nesting here in some profusion are the western gull, the tufted puffin, Cassin's auklet, one or two species of petrel, and the pigeon guillemot. All of these birds, but especially the cormorants and murre, are currently adding to guano deposits to be found toward the northern end of the island.

While on Southeast Farallon much time was devoted to shell collecting, the results of which are of such interest that a more extensive account of them is planned at a later time. However, we had heard of the possibility of finding shells in bird guano and so investigated this source without, at the outset, expecting much. To our surprise we found good hunting in the guano at certain spots—a first experience in over 40 years of collecting where one had to climb steep hills and cliffs to find recent marine species. True, the shells found scattered over the surface were covered with guano, but many of the species were from moderate depths, ordinarily taken only by dredging. For this reason it was easy to overcome a natural aversion to the conditions under which this type of hunting has to be done.

The source of shells in the guano seems rather evident. Cormorants, particularly, obtain some of the fish on which they feed in fair depths of water. Many of these fish feed on small mollusks of various types, swallowing them whole. When caught, the fish are brought in to the nesting sites where they are swallowed by the old or young birds or are torn to pieces, or are left to rot near the nests. Eventually the shells weather out, either from the guano itself or from the rotting fish and may be picked up on the surface. In some instances this weathering process must be fairly rapid, for, after cleaning, some of the shells were found to have the opercula in place although many shells had lost their periostraca. A list of the species found in the guano follows:

Pelecypoda

Cryptomya californica Conrad

Glycymeris cf. *G. subobsoleta* Carpenter

Hinnites multirugosus Gale

Volsella fornicata Carpenter

Gastropoda

Acmaca pelta Eschscholtz

Acmaca mitra Eschscholtz

Amphissa columbiana Dall
Amphissa versicolor Dall
Amphissa versicolor incisa Dall
Calliostoma costatum Martyn
Calliostoma gloriosum Dall
Crepidula adunca Sowerby
Crepidatella lingulata Gould
Fusinus (species?). Juv. specimens
Homalopoma carpenteri Pilsbry
Margarites salmonca Carpenter
Mitra montereyi Berry
Mitrella tuberosa Carpenter
Nassarius cf. *N. californianus* Conrad, *aucl*
Nassarius insculptus Carpenter
Nassarius mendicus Gould
Nassarius mendicus cooperi Forbes
Ocenebra interfossa atropurpurea Dall
Ocenebra lurida aspera Baird
Olivella baetica Carpenter
Seila montereyensis Bartsch
Tegula brunnea Philippi
Tegula pulligo Martyn
Trivia californiana Gray

Amphineura

Nuttallina californica Reeve

Anthozoa

Balanophyllia cf. *B. elegans* Verrill

Cirripedia

Balanus flos Pilsbry

Balanus nubilis Darwin

The most exciting find in the guano deposits was the following new species of *Liotia* belonging to a group not heretofore found living north of Lower California.

Liotia farallonensis A. G. Smith, new species

Plate 20, figures 2, 3, and 4

Description of the holotype: Shell of medium size for the genus, of fairly heavy substance, globose, whitish, with about four post-nuclear whorls (the nuclear whorls lost). Whorls loosely coiled, rapidly enlarging and descending, the sutures distinct, ending in a circular aperture the plane of which

approximately coincides with the axial plane of the shell. Axial sculpture of coarse ribs, subequally spaced, of which there are 12 on the body whorl and about the same number on the penultimate whorl. Spiral sculpture consisting of two prominent carinae, the first strong and located at the periphery of the whorls, the second weaker and lying below it. Base with two progressively weaker carinae which spiral down into the umbilicus.

Points where the axial and spiral sculpture cross are drawn out into blunt-pointed projecting tubercles, strongest at the periphery, giving the shell a multi-stellate aspect in the top view. Spaces between the axial and spiral ribs generally subquadrate, more elongated above the periphery in the axial direction. Basic shell sculpture rude, consisting of a thin, apparently spongy layer with a layer of nacre underneath. Aperture entire, the edge thickened by a terminal axial rib, pearly within, of a golden orange color. Operculum horny, shallowly conical, spiral, consisting of many closely set turns of vertical fin-like projections set on the horny base and decorated at the tops of an abundance of narrow strap-like projections, which tend to give the outer edge of the operculum a fringed appearance under fairly high magnification ($\times 90$). These do not extend to the center of the operculum, which is a small circular area without decoration. Altitude of shell, 10.3 mm.; maximum diameter, 12.9 mm.; altitude of aperture, 5.6 mm.; diameter of umbilicus, 1.9 mm.

Holotype: No. 9527, Calif. Acad. Sci. Dept. Paleo. Type Coll., from bird guano, **Southeast Farallon Island, California**, collected by A. G. Smith, May 10, 1949; *Paratype*, No. 9528, Calif. Acad. Sci. Dept. Paleo. Type Coll., found at the same time and at approximately the same location as the type by G. D. Hanna. The single paratype is a smaller shell, somewhat more eroded than the type, and measures: altitude, 8.4 mm.; maximum diameter, 10.2 mm.; altitude, of aperture, 4.4 mm.; diameter of umbilicus, 1.7 mm. It has about three and one quarter whorls exclusive of the lost nucleus. Two specimens were taken at Loc. 32935 (C. A. S.), Station 11 (U. S. S. *Mulberry*), Lat. $37^{\circ}59.2'$ N., Long. $123^{\circ}27.0'$ W., S. W. of Cordell Bank, in 74 fathoms, green mud.

Remarks: *Liotia farallonensis* belongs to the group including *L. californica* Dall from the Gulf of California (recently collected on Guadalupe Island by Woodbridge Williams), and *L. pacis* Dall from deep water off La Paz, Mexico, which Dall placed in the genus *Arcne* according to Strong (1934). Later Burch (1946), on Strong's authority, questionably allocated these two species to *Liotia* along with *L. c-b-adamsi* Carpenter, *L. cancellata* Gray, and *L. fenestrata* Carpenter. He places all other species in the genus *Arcne*. It therefore seems the wiser course to place this new species in *Liotia* until the differences between this genus and the genus *Arcne* are better understood.

Although both specimens are in only fair condition due to the treatment received and are somewhat eroded, the operculum of each shell was in place. Careful investigation of the one from the holotype failed to show existence of a calcareous deposit under a magnification of x 90 although some of the fins were removed with a dissecting needle.

Liotia farallonensis is at once distinguished from *L. californica* by its much smaller size and its greater number of axial ribs (12 instead of 6 per whorl). *Liotia pacis* is about the same size but has 8 ribs per whorl.

For identification of the barnacles in the preceding list and for the excellent photographs of the *Liotia* thanks are due to Mr. Frank L. Rogers of the California Academy of Sciences.

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